Conditionals in selection semantics *

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Abstract

I explore the semantic and logical prospects for reconstructing Stalnakerian truth-conditions for conditionals on a theory on which these emerge from the separate contribution of selection modals (*will* and *would*) and a restrictor theory of *if*-clauses.

1 Introduction

This paper presents an account of the interaction between conditionals and selection modals. Cariani and Santorio [6, 7] argue that modals such as *will* and *would* are neither necessity nor possibility operators, but instead operate 'world selection'.[1] I explore how this commitment illuminates some key questions concerning conditionals. The paper complements and overlaps with previous work by some fellow neo-Stalnakerians, specifically Santorio [25] and Mandelkern [22]. The overlap is virtuous: the core ideas of §§4-5 germinated more or less simultaneously, and there are many choice points at which we take different paths.

2 Selection modals

Following a strong linguistic tradition, assume that *will* and *would* share a common modal morpheme WOLL; *will* decomposes as PRES + WOLL; *would* decomposes as PAST + WOLL. Semantically, WOLL takes two arguments: a modal base $\mathbf{f}$ and a prejacent proposition. (I distinguish between the modal base *variable* f and the set theoretic object $\mathbf{f}$ it is assigned to.) It is widely believed (but by no means obvious) that the natural modal base for *will* and *would* is historical [4, 7, 13, 15], which I interpret to mean:

in context c, $\mathbf{f}(w)$ = the worlds that are duplicates of w up to the time of c.

Properly understood, this appeal to historical modal bases is neutral between several metaphysical options concerning the future, such as branching and divergence.[2]

Onto the semantics. Let σ be a selection function and $\mathcal{W}$ a background set of worlds. That is, $\sigma : \mathcal{P}(\mathcal{W}) \times \mathcal{W} \mapsto \mathcal{W}$ satisfying.

<u>success:</u> for $w \in \mathcal{W}$, $\mathbf{P} \subseteq \mathcal{W}$ with $\mathbf{P} \neq \emptyset$, $\sigma(w, \mathbf{P}) \in \mathbf{P}$

<u>centering:</u> for $w \in \mathcal{W}$, $\mathbf{P} \subseteq \mathcal{W}$ with $w \in \mathbf{P}$, $\sigma(w, \mathbf{P}) = w$

In this note, I adopt a toy treatment of the temporal role of *will* and *would* and tense more generally.[3] Let $\blacktriangleright$ map a time t to a time that is no earlier than t. The basic semantics for WOLL is as follows:

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[1] See also [3, 4]. Kratzer [18] also independently proposes a semantics along the same lines.

[2] See [20, §4.2] for the metaphysical distinctions, and [3, 7] for the neutrality arguments.

[3] For a fuller, more descriptive, proposal about the future orientation of these modals, see [4] and [3, ch. 7].

$$[\![\text{WOLL}_f(\mathsf{P})]\!]^{w,t} = 1 \text{ iff } [\![\mathsf{P}]\!]^{\sigma(\mathbf{f}(w),w),\blacktriangleright(t)} = 1$$

Present tense is given a redundant interpretation:

$$[\![\text{PRES}(\mathsf{P})]\!]^{w,t} = 1 \text{ iff } [\![\mathsf{P}]\!]^{w,t} = 1$$

We will need the non-selectional modal *might* as well—also with a plain vanilla entry. Following Condoravdi [8], assume that *might* is future-oriented, which in the current toy picture means:

$$[\![\textit{might}_f(\mathsf{P})]\!]^{w,t} = 1 \text{ iff } \exists v \in \mathbf{f}(w), [\![\mathsf{P}]\!]^{v,\blacktriangleright(t)} = 1$$

There is evidently much more to be said about the complexities of a integrated semantics for modality, tense and aspect, but none of it will be said here (see among others [4, 8, 12, 32]). I will also not explicitly spell out the consequences of my discussion for *would*-conditionals, though they are very much on the theoretical radar.

3 Stalnaker's conditional.

The selectionist approach to *will* and *would* draws inspiration from Stalnaker's account of conditionals [28, 29, 30]. According to Stalnaker, *if* P, Q is true at w iff Q is true at a world v that is the "closest" P-world to w. Here is a Stalnaker-inspired entry for a conditional connective '>', with the modification that, with later developments in mind, I throw in a modal base.

$$[\![\mathsf{P} >_f \mathsf{Q}]\!]^{w,t} = 1 \text{ iff } [\![\mathsf{Q}]\!]^{\sigma(\mathbf{f}(w)\cap\mathbf{P},w),t} = 1$$

Unlike my selectionist theory, this account associates the selection-behavior with the conditional, as opposed to the modals. Another difference between my account and Stalnaker's is that Stalnaker imposes stricter conditions on selection.

The lynchpin of Stalnaker's account is the validity of:

`CEM.` $\vdash (\mathsf{P} >_f \mathsf{Q}) \vee (\mathsf{P} >_f \textit{not}\ \mathsf{Q})$

Here I assume without argument that validating conditional excluded middle is desirable. I defer to the extensive literature to supply the relevant arguments ([5, 6, 22, 25, 29, 33]).

Just as central as `CEM` is a classic set of invalidities for the Stalnaker conditional.

`AS.` $\mathsf{P} >_f \mathsf{R} \not\vdash (\mathsf{P}\ \&\ \mathsf{Q}) >_f \mathsf{R}$

`I/E.` $\mathsf{P} >_f (\mathsf{Q} >_f \mathsf{R}) \not\dashv\not\vdash (\mathsf{P}\ \&\ \mathsf{Q}) >_f \mathsf{R}$

The conventional wisdom surrounding these is that the invalidity of `AS` is desirable, but the failure of `I/E` is not, at least for indicatives.[4] Another logical challenge to Stalnaker's analysis involves the relation between *if* and *might*. These pairs seem contradictory:

(1) a. If Keith plays, Mick will sing.
 b. If Keith plays, Mick might not sing.

(2) a. If Keith had played, Mick would have sung.
 b. If Keith had played, Mick might not have sung.

[4] See [23] for treatment of some alleged counterexamples to indicative `I/E`. Mandelkern also highlights that the subjunctive conditional case is very different when it comes to `I/E`.

The Stalnaker conditional does not deliver these incompatibilities. This drove Stalnaker to the heroic but not widely accepted idea that the *might* in (1-b) is a wide-scoped epistemic operator.

It is helpful to identify the truth-conditions that are predicted for (1-a). Since the conditional already provides a selection function, a Stalnakerian analysis of the meaning of (1-a) naturally requires a purely temporal analysis of *will*. To keep this purely temporal meaning distinct from the selectionist one, introduce the operator FUT endowed with a purely temporal semantics.

$$[\![\textsc{fut}\ \mathsf{P}]\!]^{w,t} = 1 \text{ iff } [\![\mathsf{P}]\!]^{w,\blacktriangleright(t)} = 1.$$

Letting '**keith plays**' denote the proposition that Keith plays at the relevant time, this semantic package predicts the following truth-conditions:

(3) $[\![(1\text{-a})]\!]^{w,t} = [\![\text{Keith plays} >_f \text{Mick sings}]\!]^{w,t} = [\![\text{Mick sings}]\!]^{\sigma(\mathbf{f}(w)\cap\textbf{keith plays},w),\blacktriangleright(t)}$

Any plausible truth-condition for (1-b) should be compatible with this.

4 The basic equivalence

The formal fact at the center of this paper is that, within a selectionist framework for *will*, it is possible to reconstruct Stalnakerian truth-conditions for *will*-conditionals by a different route. This route generates a different set of predictions about the validity of inference patterns. (One would want to say a different *logic for the conditional* if the syntactic differences didn't make a proper logical comparison less than straightforward.) This section takes up these points in turn.

For purposes of integration with the selection semantics for *will*, assume a restrictor analysis for *if* clauses [16, 17]. Since we have syntacticized modal bases, this means adopting a treatment of conditionals antecedent as assignment shifters along lines that are presented by von Fintel [9] and applied to selectionist *will*-conditionals by Cariani and Santorio in [7]. To avoid dealing explicitly with assignment functions, I give a somewhat coarser presentation of the idea than either of these sources Let $f + \mathbf{P}$ be the result of operating on the assignment function so that f is assigned to $\lambda w.\mathbf{f}(w) \cap \mathbf{P}$. Whatever the exact entry for *if* (there are choices we don't need to consider here), it needs to deliver this constraint (where $\mathbf{P}$ denotes the set of P-worlds):

$$[\![(\textit{if}\ \mathsf{P})((\textsc{tense}+)\textsc{modal}_f\ \mathsf{Q})]\!]^{w,t} = 1 \text{ iff } [\![(\textsc{tense}+)\textsc{modal}_{f+\mathbf{P}}\ \mathsf{Q}]\!]^{w,t} = 1$$

The key claim I intend to establish is that the restriction + selection analysis of *will*-conditionals delivers the same truth-conditions as Stalnaker's analysis of *if* combined with a temporal analysis of *will* (as specified in the semantics of FUT). This is easily ascertained:

$$[\![(\textit{if}\ \text{Keith plays})(\textsc{pres}(\textsc{woll}_f(\text{Mick sings}))]\!]^{w,t} =$$

$$[\![\textsc{pres}(\textsc{woll}_{f+\textbf{keith plays}}(\text{Mick sings})]\!]^{w,t} = [\![\text{Mick sings}]\!]^{\sigma(\mathbf{f}(w)\cap\textbf{keith plays},w),\blacktriangleright(t)}$$

These are precisely the truth-conditions we predicted in (3) within the Stalnakerian framework for *Keith plays* $>_f$ FUT(*Mick sings*). This moral is fully general: combining selection semantics for *will* with the restrictor analysis predicts Stalnakerian truth-conditions for *will*-conditionals.

Let us move on to the predictions about logic. A form of CEM is valid for *will*-conditionals:

`CEM-w.` $\vdash (\textit{if}\ \mathsf{P})(\textit{will}_f\ \mathsf{Q}) \vee (\textit{if}\ \mathsf{P})(\textit{will}_f\ \textit{not}\ \mathsf{Q})$

Interestingly, in addition to this, the semantics validates an analogue of (I/E), appropriately restricted to *will*-conditionals.

$$\texttt{I/E-w.} \quad (\textit{if}\ \mathsf{P})(\textit{if}\ \mathsf{Q})(\textit{will}_f\ \mathsf{R}) \dashv\vdash (\textit{if}\ \mathsf{P}\ \&\ \mathsf{Q})(\textit{will}_f\ \mathsf{R})$$

I'm glossing over some needed syntactic work here by assuming it's possible for two *if*-clauses to independently restrict a single modal.

We still have no account of the duality between *will*-conditionals and their *might*-counterparts. In other words, we predict:

$$\texttt{WM-w.} \quad (\textit{if}\ \mathsf{P})(\textit{will}_f\ \mathsf{Q}), (\textit{if}\ \mathsf{P})(\textit{might}_f\ \textit{not}\ \mathsf{Q}) \nvdash \bot$$

This inference is not classically valid: $(\textit{if}\ \mathsf{P})(\textit{will}_f\ \mathsf{Q})$ and $(\textit{if}\ \mathsf{P})(\textit{might}_f\ \textit{not}\ \mathsf{Q})$ can both be true. As Santorio [25] notes, the dialectic surrounding `WM` closely mirrors the dialectic surrounding epistemic contradictions—sentences of the form $\mathsf{P}\ \&\ \textit{might not}\ \mathsf{P}$—on the sort of analysis favored by Yalcin [34]. One paradigmatic approach to these is to invoke a more permissive notion of consequence than the classical concept of preservation of truth at an index. Following the dynamic tradition, and more locally [31, 34], introduce a concept of *acceptance*, and define a concept of entailment as preservation of acceptance, so that every truth-preserving argument is also acceptance-preserving.[5] This move might appear conceptually unmotivated in a straightforwardly contextualist semantic framework. There are two possible paths to address this worry: one is to take the semantic framework in more 'information'-friendly direction; the other is to suggest that the informational notion of consequence can serve as a pragmatic overlay on top of a contextualist semantics. I believe both paths are viable. Here, however, I illustrate a way of walking down the first path, deferring more extensive discussion to [3].

Let s be an information state—modeled, as usual a set of worlds. Lift semantic values so that indices also have an information state coordinate. At this point, the standard path would be to define a concept of acceptance and use it to define informational entailment. However, the present framework needs to coordinate the relationship between information states and modal bases. Say that information state s *accepts* P (in context c) iff for all $v \in s$, $[\![\mathsf{P}]\!]^{s,v,t_c} = 1$. Suppose that, for each time t, the background model fixes the historical modal base at t ($\mathbf{h}_t$). Say that an information state s is *historically eligible* in context c if and only for every world $w \in s$, $\mathbf{h}_{t_c}(w) \in s$. Informally, we zero-in on those information states s such that the relevant historical modal base function in c does not map from inside to outside of s. Because historical modal bases represent equivalence relations (specifically: duplication up to a time), they induce partitions. Under these assumptions, the eligible information states (in c) can be equivalently characterized as those states that do not cut through the cells of the historical partition determined by $\mathcal{M}$ at t_c. Finally, say that an argument with premises $\mathsf{P}_1, ..., \mathsf{P}_x$ and conclusion R is a *coordinated informational entailment* (written $\mathsf{P}_1, ..., \mathsf{P}_x \vdash_{c\text{-}info} \mathsf{R}$) iff for any context c, no information state s that is *historically eligible* in c accepts each of the P_i's (in c) but fails to accept R (in c).

Anything that is valid in the truth-preservation sense (and specifically `I/E`) is informationally valid—a standard fact about informational consequence that also holds for its coordinated variant. Furthermore, though not classically valid, `WM`-w is informationally valid.

$$\texttt{WM-w.} \quad (\textit{if}\ \mathsf{P})(\textit{will}_f\ \mathsf{Q}), (\textit{if}\ \mathsf{P})(\textit{might}_f\ \textit{not}\ \mathsf{Q}) \vdash_{c\text{-}info} \bot$$

This completes the presentation of the basic framework.[6]

[5] This is the general approach Santorio takes in his path semantics [25], though Santorio goes for a more radical revision of the fundamental objects of the semantics than what I am exploring here.

[6] If we are willing to move to a more standard dynamic framework and to assume that *will* selects out of an information state, we can avoid some of these novelties. Set times aside and evaluate relative to information state/world pairs:

$$[\![\mathsf{P} > \mathsf{Q}]\!]^{s,w} = 1 \text{ iff } [\![\mathsf{Q}]\!]^{s\cap\mathsf{P},w} = 1$$

5 Stalnaker's conditional factorized.

So far, I focused on conditionals with *will* in their consequents, elaborating a picture that was already outlined in [7]. We can try something more general and assign *all* conditional sentences broadly Stalnakerian truth-conditions while also having an logic that classically vindicates generalizations of `CEM` and `I/E`, as well as informationally vindicating `WM`.

The standard idea associated with Kratzer's restrictor approach is that, when *if* lacks an overt modal to restrict, a covert necessity modal is posited in the LF. In particular:

(4) If Keith played, Mick sang.

gets reconstructed as:

(5) (*if* Keith played)(MUST$_f$ Mick sang)

It is natural to wonder what would happen if instead of positing a covert necessity modals, we posited covert *selection* modals (this analysis is independently entertained but not endorsed in [22]). Suppose for instance that (4) gets assigned the logical form in (6) (from now on, I omit the redundant present tense):

(6) (*if* Keith played)(WOLL$_f$ Mick sang)

Evidently, (5) and (6) differ in truth-conditions.

(7) a. $[\![(5)]\!]^{w,t} = 1$ iff $\forall v \in \mathbf{f}(w) \cap \textbf{keith played}$, $[\![\text{PAST } \textit{Mick sing}]\!]^{v,t} = 1$
b. $[\![(6)]\!]^{w,t} = 1$ iff $[\![\text{PAST } \textit{Mick sing}]\!]^{\sigma(\mathbf{f}(w)\cap\textbf{keith plays},w),\blacktriangleright(t)} = 1$

Remarkably, the logical form in (6) delivers fully Stalnakerian truth-conditions for (4).

This analysis accounts for the plausibility of those surface forms that appear to instantiate conditional excluded middle like:

(8) Either Mick sang if Keith played or Mick didn't sing if Keith played.

More precisely, the following holds:

`CEM-c.` $\vdash (\textit{if}\ \mathsf{P})(\text{WOLL}_f\ \mathsf{Q}) \vee (\textit{if}\ \mathsf{P})(\text{WOLL}_f\ \textit{not}\ \mathsf{Q})$

As before in addition to `CEM-c` the semantics classically (and thus informationally) validates a pattern that accounts for instances of import/export involving bare conditionals.

`I/E-c.` $(\textit{if}\ \mathsf{P})(\textit{if}\ \mathsf{Q})(\text{WOLL}_f\ \mathsf{R}) \dashv\vdash (\textit{if}\ \mathsf{P}\ \&\ \mathsf{Q})(\text{WOLL}_f\ \mathsf{R})$

Interestingly, the system makes available a second logical form for `I/E`, which is however invalid.

`I/E-c2.` $(\textit{if}\ \mathsf{P})(\text{WOLL}_f(\textit{if}\ \mathsf{Q})(\text{WOLL}_f\ \mathsf{R})) \not\dashv\not\vdash (\textit{if}\ \mathsf{P}\ \&\ \mathsf{Q})(\text{WOLL}_f\ \mathsf{R})$

There are some interesting questions to press about `I/E-c2`. On the one hand, it incorporates the fascinating suggestion that there might be a way of defining a binary conditional connective with Stalnakerian truth-conditions *and* logic inside a restrictor theory: just say that $\mathsf{P} \rightarrow \mathsf{Q} = (\textit{if}\ \mathsf{P})(\text{WOLL}_f\ \mathsf{Q})$. On the other, it raises question about how responsible the theory ought to be

$[\![\textit{will}\ \mathsf{P}]\!]^{s,w} = 1$ iff $[\![\mathsf{P}]\!]^{s,\sigma(s,w)} = 1$

This will deliver `CEM`-w, `I/E`-w and `WM`-w on a standard dynamic notion of entailment. Thanks to Simon Goldstein for making the point. The original inspiration for this account is Mandelkern's [21] reconstruction of McGee's semantics from [24]).

for the predictions of these additional structures. Does the validity of `I/E-c` properly account for the felt intuitive validity of import/export, given that there is a *very nearby* LF that is invalid? I will say a bit more about this towards the end.

A generalization of the approach in the previous section will also deliver the informational validity of an analogue of `WM` .

`WM-c.` $(\textit{if}\ \mathsf{P})(\text{WOLL}_f\ \mathsf{Q}), (\textit{if}\ \mathsf{P})(\textit{might}_f\ \textit{not}\ \mathsf{Q}) \vdash_{\textit{c-info}} \bot$

This, then, is the core of the account of conditionals that emerges if we start with selection modals and work our way out to a general approach to conditional meaning.

The news value of this tale is this: conventional wisdom has it that Stalnakerians are forced into a tradeoff between `CEM` on the one hand, and `I/E` and `WM` on the other. Stalnaker's semantics accounts for the evidence for `CEM` at the cost of invalidating `I/E` and `WM`, which has invited some uncomfortable resistance strategies. Associating selection behavior with some modals shakes up the `I/E` dialectic, while moving towards coordinated informational consequence recovers `WM`.[7]

6 Counterhistorical restriction.

The proposal of §5 posits a covert WOLL in the logical structure of bare conditionals. What modal base should it have? If this covert operator is to parallel overt *will*, we should expect it (in light of our present assumptions) to have a historical modal base. As Simon Goldstein and John Hawthorne (p.c.) note, this hypothesis falters on counterhistorical antecedents—those antecedents that are incompatible with the settled history up to the time of the context. Suppose that in w, Ann takes a test on Tuesday. On Wednesday, I say:

(9) If Ann took her test on Monday, it was graded on Tuesday.

If the restriction of WOLL is historical, $\mathbf{f}(w)$ is the set of worlds that duplicate w up to the time of my utterance. That means that, at every world in $\mathbf{f}(w)$, Ann took the test on Tuesday, and so the restriction with the antecedent of (11) is vacuous.[8]

A natural alternative—and a solution to this problem—is to assign that covert WOLL an epistemic modal base. It is convenient, but philosophically quite substantial, to assume that at any given time, the epistemic modal base is a coarsening of the historical one. Let $\mathbf{h}_t$ be the historical modal base at t and $\mathbf{e}_t$ be the epistemic modal base at t.

$$\forall w, v, \forall t : \text{if } v \in \mathbf{h}_t(w),\ v \in \mathbf{e}_t(w)$$

The informal meaning of this constraint is that worlds can only be distinguished by the epistemic modal base (at t) if they there is some qualitative difference between them (at t).

The assumption that the covert WOLL has an epistemic modal base correctly handles (11). The spirit of the objection is not yet defeated, however: *will*-conditionals still rely on historical modal bases. Given that, the problem seems to reappear for counterhistorical *will*-conditionals, like:

(10) If Ann took her test on Monday, it will be graded on Thursday.

[7] The most prominent alternative for validating all of these principles goes *homogeneity*-based account of conditionals [10, 1, 26, 5]. In this paper, I am not concerned with arguing against homogeneity-based accounts—in part because the theory of homogeneity is itself in flux ([19]) and in part because there are some problems for some of the existing formulation ([7, 25]).

[8] Though I haven't specified how the selection function is to operate on the empty set, this is certainly problematic: all counterhistorical conditionals would depend only on what goes on at a single world.

I propose that examples like (10) motivate importing an idea that proponents of restrictor approaches have been advocating independently. Sometimes, a covert modal is posited even in the presence of an overt modal [11, 14]. As before, I differ from this tradition in positing selection modals all the way down. The result is that the logical form of (10) is something like:

(11) $(if_{\,1}\ test\ monday)(\text{WOLL}_{f1}\ will_{f2}\ grade\ thursday)$

Suppose that $f1$, which is co-indexed with the *if*-clause, is assigned to the epistemic modal base **e**, while $f2$ is assigned to the historic modal base **h** (at the relevant times). This allows for non-vacuous counterhistorical restriction, because it is the **e**, and not **h**, that gets the restriction:

(12) $[\![(11)]\!]^{w,t} = [\![grade\ thursday]\!]^{\sigma(\mathbf{h}(\sigma(\mathbf{e}(w)\cap \textbf{test monday}, \blacktriangleright(t))), \blacktriangleright(t))}$

In support of this move, I note that it is independently needed, not only in the class of cases that standardly motivate double modalization, but even in cases that are extremely close to the present dialectic. Suppose that the language contains *some* historical modals like the cumbersome but intelligible *it is historically necessary that*. Then, consider the conditional,

(13) If Ann took her test on Monday, it is historically necessary that it will be graded on Tuesday.

For the reasons explored above, we cannot treat (13) as involving a counterhistorical restriction on the historical necessity modal. The only sensible strategy within a restrictor analysis is to posit a covert modal for the *if*-clause to restrict.

7 On the proliferation of covert modals.

Mandelkern [22] sketches and rejects an account of conditionals like the one from §5. His first concern is that the heavy reliance on covert modals is suspect for reasons having to do with learnability of conditional constructions across languages (see also [27]).

> How do we learn to insert covert modals in all the needed places? And how do we learn which modal to put in? We can imagine a wide array of options that would seem to be open to children concerning what kind of modal we put in (existential? universal? epistemic, deontic, metaphysical?) as well as when to insert them (always? sometimes? never?). How do children (both within and across languages) converge on the correct combination? [22, p. 312]

It is hard to address this challenge without a major digression, and this is not the place for that. But I believe the challenge is not as pressing as Mandelkern suggests. For one thing, figuring out force and flavor of covert modals is not significantly harder than figuring out force and flavor of overt ones. Setting this point aside, it is not clear exactly what children are supposed to not be able to do. On most standard models for acquisition, children can entertain and test syntactic and semantic hypotheses of the relevant complexity: slotting covert elements into the relevant LFs and fixing the relevant parameter values involves searching and testing a relatively small hypothesis space.

There are also less direct reasons for caution. If there is a problem with covert modals here, then there is a problem in all the other places where semanticists have found it plausible to resort to covert modalities. Furthermore, if there is a problem with covert *modals*, then there likely is a problem with covert *elements* more generally. Semantics without covert elements would be a respectable research program, but it comes with a large unfinished agenda. In light of these considerations, I submit that we have no evidence that the theory is unlearnable.

8 Collapse and the identity principle.

Mandelkern's second concern concerns the logic of the conditional. Accounts that validate `I/E` fail to deliver the validity of an impressively intuitively compelling schema—the identity schema *if* P, *then* P. More specifically, [23] argues that Identity is involved in a striking collapse result in which the only other reasonable culprit is `I/E`. Let '$\rightarrow$' be a conditional connective. Identity, together with a weak monotonicity constraint, yields the principle:

(EC) if P entails Q, $\vdash \mathsf{P} \rightarrow \mathsf{Q}$

Here are two consequences of (EC):

(14) a. $\vdash (\neg(\mathsf{P} \rightarrow \mathsf{Q}) \ \&\ \mathsf{Q}) \rightarrow \neg(\mathsf{P} \rightarrow \mathsf{Q})$
b. $\vdash ((\neg(\mathsf{P} \rightarrow \mathsf{Q}) \ \&\ \mathsf{Q}) \ \&\ \mathsf{P}) \rightarrow \mathsf{Q}$

However, applying import/export reasoning to (14-b) yields:

(15) $\vdash (\neg(\mathsf{P} \rightarrow \mathsf{Q}) \ \&\ \mathsf{Q}) \rightarrow (\mathsf{P} \rightarrow \mathsf{Q})$

If so, $(\neg(\mathsf{P} \rightarrow \mathsf{Q}) \ \&\ \mathsf{Q})$ (the common antecedent of (14-a) and (15)) is logically false, and collapse follows (details in §3 of [23]). Mandelkern rejects the `I/E` step and develops an impressive theory which accounts for why `I/E`—though invalid—seems to not fail in the indicative domain.

My first reaction to this argument would be to reach for a bullet-biting, `I/E`-supporting response. Restrict Identity to its non-junk instances (this is part of a more general line of responses to collapse results that is briefly entertained in [5]). The strategy would grant that Identity is a simple-looking principle in conditional semantics, but resist the idea that the intuitive support for it extends to cases in which P is instantiated by complex, conditional-embedding (and possibly even contradictory) sentences such as $((\neg(\mathsf{P} \rightarrow \mathsf{Q}) \ \&\ \mathsf{Q}) \ \&\ \mathsf{P})$.[9]

However, a more concessive reply is also available, if one were so inclined. It is possible within the present framework to embrace the core tenets of Mandelkern's [23, §6-7] positive proposal. This involves invalidating `I/E` but recovering the prediction that there are no outright counterexamples to `I/E` by capturing it as valid under a more permissive, 'pragmatic', notion such as (a modernized version of) Strawson entailment.

Here is a (too) compressed presentation of Mandelkern's framework. First: have the interpretation function keep track of the presuppositional content of expressions, though not in the standard trivalent way. In particular, given input sentence P, the interpretation function outputs a pair whose first coordinate is 1 if the presuppositions of P are satisfied and 0 otherwise; the second coordinate of the pair is the standard truth-value of P. Second: say that P is *Strawson-valid* iff for all models and indices P's semantic value is $\langle 1, 1\rangle$ or $\langle 0, *\rangle$ where '*' is a placeholder for either 1 or 0. By contrast, P is *logically valid* iff it is guaranteed to have semantic value $\langle *, 1\rangle$. Informally: logical validity is guaranteed truth, while Strawson validity is guarantee of a status that is either truth with presuppositions being satisfied or presupposition violation. Third: enrich indices a parameter for keeping track of 'local contexts'. Fourth: assume that the

[9] Even if this were right, this argument would not end here. Someone who wanted to bite the bullet would have to reply to Mandelkern's case for Identity in §4.2 of [23].

indicative conditional $\mathsf{P} \to \mathsf{Q}$ presupposes a 'local' version of Stalnaker's indicative constraint.[10] If that was too dense, here is an implementation of the semantics of the indicative conditional:

(16) $[\![\mathsf{P} \to \mathsf{Q}]\!]^{\kappa,w} =$
$$\langle 1,*\rangle \text{ iff } \forall v \in \kappa, \sigma([\![\mathsf{P}]\!]^{\kappa}, v) \in \kappa$$
$$\langle *,1\rangle \text{ iff } [\![\mathsf{Q}]\!]^{\kappa\cap[\![\mathsf{P}]\!]^{\kappa},\sigma([\![\mathsf{P}]\!]^{\kappa},w)} = \langle 1,1\rangle$$

This semantics Strawson-validates `I/E`, even though the inference is not logically valid.

My concluding point is that it is possible to replicate Mandelkern's story within my framework. Earlier, I noted that we have built a kind of conditional connective with the form $(\textit{if}\ \mathsf{P})(\textsc{woll}_f\mathsf{Q})$. The present idea is to translate everything that Mandelkern says about $\mathsf{P} \to \mathsf{Q}$ in terms of $(\textit{if}\ \mathsf{P})(\textsc{woll}_f\ \mathsf{Q})$. Nearly every part of the story carries over smoothly. The only element that requires special attention is the implementation of the indicative constraint. Instead of associating this with the conditional, associate it with WOLL. As a result, $\textsc{woll}_f(\mathsf{Q})$ presupposes in w that for every world $v \in \kappa$, $\sigma(\mathbf{f}(w), v) \in \kappa$ (note the reinstatement of modal bases which are not part of Mandelkern's setup). For WOLL-conditionals, this analysis works out to:

(17) $[\![(\textit{if}\ \mathsf{P})(\textsc{woll}_f\mathsf{Q})]\!]^{\kappa,w} =$
$$\langle 1,*\rangle \text{ iff } \forall v \in \kappa, \sigma(\mathbf{f}(w) \cap [\![\mathsf{P}]\!]^{\kappa}, v) \in \kappa$$
$$\langle *,1\rangle \text{ iff } [\![\mathsf{Q}]\!]^{\kappa\cap[\![\mathsf{P}]\!]^{\kappa},\sigma(\mathbf{f}(w)\cap[\![\mathsf{P}]\!]^{\kappa},w)} = \langle 1,1\rangle$$

For full comparability with the theories in this paper we'd have to reinstate a time coordinate, but that can be done modularly.

In §5, I pointed out that `I/E` might get one of two forms: either `I/E-c` or:

`I/E-c2.` $(\textit{if}\ \mathsf{P})(\textsc{woll}_f(\textit{if}\ \mathsf{Q})(\textsc{woll}_f\ \mathsf{R})) \dashv\vdash (\textit{if}\ \mathsf{P}\ \&\ \mathsf{Q})(\textsc{woll}_f\ \mathsf{R})$

I also noted then that it is puzzling that we don't detect a truth-conditional difference corresponding to this distinction. Interestingly, under (17), `I/E-c2` goes through as a Strawson equivalence in the same, rather nuanced sense, in which Mandelkern's conditional Strawson-validates `I/E`.

The upshot of this round of Mandelkern vs. Mandelkern is this: contrary to a claim in [22], the development in [23] is not an obstacle for the factorized Stalnakerian analysis. It might even illuminate why we don't detect a difference in readings corresponding to two possible construals of `I/E`. Whether the factorized analysis is tenable in full generality remains to be seen.

References

[1] Maria Bittner. Topical referents for individuals and possibilities. In R. Hastings, B. Jackson, and Z. Zvolenszky, editors, *Semantics and Linguistic Theory*, volume 11, pages 36–55, 2001.

[2] David Boylan and Ginger Schultheis. The qualitative thesis. Rutgers University and the University of Chicago, ms.

[3] Fabrizio Cariani. *The Modal Future*. Cambridge University Press, forthcoming.

[4] Fabrizio Cariani. The modal future hypothesis debugged. Northwestern University, ms.

[5] Fabrizio Cariani and Simon Goldstein. Conditional heresies. *Philosophy and Phenomenological Research*, forthcoming.

[6] Fabrizio Cariani and Paolo Santorio. Selection semantics for *Will*. In *Proceedings of the 19th Amsterdam Colloquium*. 2017.

[7] Fabrizio Cariani and Paolo Santorio. *Will* done better: Selection semantics, future credence, and indeterminacy. *Mind*, 127:129–165, 2018.

[10] See also [2] for an alternative, non-presuppositional 'localization' of the indicative constraint.

[8] Cleo Condoravdi. Temporal interpretation of modals: Modals for the present and for the past. In D. Beaver, L. Casillas, B. Clark, and S. Kaufmann, editors, *The Construction of Meaning*, pages 59–88. CSLI Publications, Palo Alto, CA, 2002.

[9] Kai von Fintel. *Restrictions on Quantifier Domains.* PhD thesis, UMass, Amherst, 1994.

[10] Kai von Fintel. Bare plurals, bare conditionals, and *Only*. *Journal of Semantics*, 14:1–56, 1997.

[11] Annette Frank. *Context Dependence in Modal Constructions.* PhD thesis, University of Stuttgart, 1997.

[12] Atle Grönn and Arnim von Stechow. Tense. In M. Aloni and S. Dekker, editors, *The Cambridge Handbook of Formal Semantics, Part III*, pages 313–341. CUP, 2016.

[13] Michela Ippolito. *Subjunctive Conditionals.* MIT Press, 2013.

[14] Magdalena Kaufmann and Stefan Kaufmann. Conditionals and modality. In S. Lappin, editor, *The handbook of contemporary semantic theory*, pages 274–312. Wiley, 2015.

[15] Stefan Kaufmann. Conditional truth and future reference. *Journal of Semantics*, 22(3):231–280, 2005.

[16] Angelika Kratzer. Conditionals. In A. von Stechow & D. Wunderlich, editor, *Semantics: An International Handbook of Contemporary Research.* De Gruyter, 1991. from the *Semantics Archive.*

[17] Angelika Kratzer. *Modals and Conditionals.* Oxford University Press, 2012.

[18] Angelika Kratzer. Chasing hook. In Lee Walters and John Hawthorne, editors, *Conditionals, Probability, and Paradox.* Oxford University Press, forthcoming.

[19] Manuel Križ. *Aspects of homogeneity in the semantics of natural language.* PhD thesis, University of Vienna, 2015.

[20] David Lewis. *On the Plurality of Worlds.* Blackwell, 1986.

[21] Matthew Mandelkern. Import-export and 'and'. *Philosophy and Phenomenological Research*, forthcoming.

[22] Matthew Mandelkern. Talking about worlds. *Philosophical Perspectives*, forthcoming.

[23] Matthew Mandelkern. If p, then p. Oxford University, ms.

[24] Vann McGee. A counterexample to *Modus Ponens*. *Journal of Philosophy*, 82:462–471, 1985.

[25] Paolo Santorio. Conditional excluded middle in informational semantics. In *Proceedings of the 21st Amsterdam Colloquium*, pages 385–394, 2017.

[26] Philippe Schlenker. Conditionals as definite descriptions. *Research on language and computation*, 2(3):417–462, 2004.

[27] Katrin Schulz. Troubles at the semantics/syntax interface: Some thoughts about the modal approach to conditionals. In *Proceedings of sinn und bedeutung*, volume 14, pages 388–404, 2010.

[28] Robert Stalnaker. A theory of conditionals. *Studies in Logical Theory, American Philosophical Quarterly*, Monograph Series 2:98–112, 1968.

[29] Robert Stalnaker. A defense of conditional excluded middle. In W.L. Harper, G.A. Pearce, and R. Stalnaker, editors, *Ifs*, pages 87–104. Springer, 1981.

[30] Robert Stalnaker and Richmond H. Thomason. A semantic analysis of conditional logic. *Theoria*, 36(1):23–42, 1970.

[31] Frank Veltman. Defaults in update semantics. *Journal of Philosophical Logic*, 25:221–261, 1996.

[32] Arnim von Stechow and Sigrid Beck. Events, times and worlds - an LF architecture. In C. Fortmann, A. Lübbe, and I. Rapp, editors, *Situationsargumente im Nominalbereich*, pages 13–47. de Gruyter, 2015.

[33] Robert J. Williams. Defending conditional excluded middle. *Noûs*, 44(4):650–668, 2010.

[34] Seth Yalcin. Epistemic modals. *Mind*, 116(4):983–1027, 2007.